1. INTRODUCTION

This report constitutes an update to Section 6 of HydroQual (1997). In Section 6 of that report, the proportion of fish in the Southern California Bight with total DDT concentrations exceeding critical values was determined for each of several spatial segments as defined in that report. Since the release of the 1997 report, additional data have become available, the time periods over which the analysis of exceedances are required by NOAA have changed, and the method of calculation was revised. In addition, the spatial segmentation was modified for this analysis. The spatial segmentation, time periods and methods of analysis are described in section 3 below. In addition, the original analysis was performed for the entire Southern California Bight, while the analysis described herein was limited to the Palos Verdes Shelf.

Two critical concentrations of total DDTs in edible tissue were evaluated. Only measurements in muscle (fillet) were used in this analysis. (1) An action level of 5.0 ppm total DDTs in edible fish tissue was established by the Food and Drug Administration. Exceedances were calculated for 5.0 ppm over two time periods, as communicated by NOAA (John Cubit, personal communication, April, 2000): 1981-1986 and 1987-1991.

(2) In 1991, the California Office of Environmental Health Hazard Assessment (OEHHA) issued "A Study of Chemical Contamination of Marine Fish From Southern California: II. Comprehensive Analysis." (Pollock 1991). Therein, the State established a human health-based trigger level of 0.1 ppm total DDTs in muscle tissue for fish. For fish species and sites with average DDT concentrations which exceed the trigger level, the State recommended that anglers either not consume or limit consumption of fish species. Exceedance values for 0.1 ppm were calculated for the period after 1991.

2. DATA SOURCES

The analysis of exceedances was performed for white croaker, Dover sole, kelp bass and black surfperch. A subset of the database developed by HydroQual (1997), supplemented with recently received data, was used. This subset included muscle samples from 1981 to 1995 that fell within the spatial segmentation scheme described in section 3. The original sources for these data are the Los Angeles County Sanitation District (LACSD), Risebrough (1987), and the Santa Monica Bay Restoration Project (SCCWRP et al. 1992). Data from Pollock's 1991 study were excluded, because these data were found to be biased low (Pollock et al. 1991, HydroQual 1997). Comparison of the database to the annual reports from LACSD showed that ten white croaker samples from 1992 were missing from the database. The missing data were emailed by NOAA (John Cubit, email, April, 2000) and included in the database update.

The database was supplemented with additional data from the Los Angeles County Sanitation district (LACSD) and from a report by Love and Hansen (Love and Hansen 1999). Recent data from LACSD was received via email from Jan Stull of LACSD, forwarded by John Cubit of NOAA. They include 160 muscle samples collected in 1996 and 1997. According to Jan Stull, LACSD measurements of DDT in fish from the Palos Verdes Shelf are not available after 1997. Data values were taken directly from the report published by Love and Hansen (1999). Love and Hansen's dataset consists of 45 white croaker muscle samples taken near Whites Point and Bunker Point in 1999. Table 1 summarizes the updated database for white croaker, dover sole, kelp bass, and black surfperch.

Total DDT concentrations were used in the calculation of exceedances. Where these were not available, they were estimated by dividing pp'DDE concentrations by 0.87 (HydroQual 1997). This occurred for less than forty white croaker and kelp bass samples collected in 1985 and 1990, about 5% of the database used for the analysis.

Table 1. Data Sources				
Source	White Croaker	Dover Sole	Kelp Bass	Black Surfperch
LACSD	197 (1985-1997)	210 (1983-1996)	217 (1981-1996)	99 (1981-1996)
Santa Monica Bay Restoration Project (SCCWRP et al. 1992)	16 (1990)			
Risebrough 1987			16 (1985)	
Love and Hansen 1999	45 (1999)			

3. METHOD OF ANALYSIS

3.1 Spatial Segmentation

The data for the Palos Verdes Shelf were divided into eight spatial segments, using a modified version of the segmentation scheme developed by HydroQual (1997). One additional segment was added, between segments 4 and 5, and called 4A (Figure 1). This was done to ensure that all fish samples collected by LACSD in their Zone 2 and transect T1 were included in the same QEA segment. In addition, the border between segments 3 and 4 was adjusted to follow the bathymetric contours off Palos Verdes Point. This did not affect the calculation of exceedances, as no data were collected in the region previously in segment 4 and now in segment 3. Two other modifications were performed. Data from Hermosa Point and Hermosa Pier were excluded because these locations lie outside the area considered for the biomass analysis (Ambrose 2000). LACSD's transect T5 data was reassigned from segment 8 to segment 9, because most of the trawl line lies within segment 9.

For all species except white croaker, exceedances were calculated using all samples within each segment in each appropriate time period for each species. For white croaker, exceedances were calculated separately for shallower and deeper regions of each segment. The exceedances for the shallow regions were based upon the data collected by Love and Hansen (1999) in segments 6 and 7 in depths ranging from 20 to 30 m. The exceedances for the deeper regions were calculated using all of the remaining data. The remaining white croaker samples were dominated by data collected by the Los Angeles County Sanitation District at approximately 50m depth.

3.2 Time Periods

Temporal trends in total DDT concentrations were explored to aid in developing a method by which exceedances could be estimated (Figures 2 through 7). Trends were examined on both a wet weight and a lipid basis. Not every value presented on a wet weight basis could be presented on a lipid basis, because lipid measurements were not available for all DDE measurements. The sources of the data in Figures 2 through 7 are listed in Table 1.

The FDA action level of 5.0 ppm. To estimate the exceedance of the FDA action level of 5.0 ppm in all species, except white croaker in shallow waters, data collected between 1981 and 1986 were used to estimate exceedances for this period, and data collected between 1987 and 1996 were used to estimate exceedances for the period 1987 to 1991 (Table 2). Data collected after 1991 were included to increase sample size. This approach may underestimate actual exceedances, because, in general, the evidence for the existence of temporal trends in the DDT levels to which the fish have been exposed since 1987 is ambiguous, and, if there is a trend, a downward trend is expected (Figures 2 through 7, HydroQual 1997). As described below, if data were unavailable for a given segment for 1981-1986, then exceedances calculated for 1987-1991 could be used. This provided a lower bound estimate of exceedances for the earlier period.

For white croaker in shallow waters, the only data available were collected in 1999 in segments 6 and 7 (Love and Hansen 1999). The DDT concentrations measured by Love and Hansen (1999) are lower than the rest of the data that are available in the QEA database for the same segments (data available to 1997). For the purpose of this analysis, Love and Hansen's values were used to represent DDT concentrations in shallow waters of the Palos Verdes Shelf for all years. It is unclear whether and to what degree the concentrations in white croaker caught in shallow waters are in general truly lower than levels in deeper waters, because: (1) there are no data available in deeper waters for 1999 for comparison; (2) the Love and Hansen data were collected in a different season than the other data in the database; (3) there may be differences in analytical techniques between studies; (4) the fish collected by Love and Hansen exhibited lipid contents that differed considerably from those in the rest of the database; and (5) on a lipid-normalized basis, the measurements of Love and Hansen are more similar to the other available data than on a wet weight basis (compare Figures 2 and 3, segment 7). Thus, the use of Love and Hansen's data to represent shallow waters provides an estimate that may be biased low relative to the true values. In addition, the resulting exceedances for the shallow waters of the Palos Verdes Shelf underestimate actual exceedances, because a value of zero was used for segments 3, 4, 4A, 5, 8 and 9. Finally, the use of Love and Hansen's data for years prior to 1999 also provides a lower bound estimate of the true values, as temporal trends are expected to be either non-existent or downward.

The California trigger level of 0.1 ppm. The data collected after 1991 were used to estimate exceedances for the period after 1991. For kelp bass and black surfperch, the most recent data were collected in 1996. The exceedances calculated using these data are considered applicable through 1996. For Dover sole and for white croaker in deeper waters, the most recent data were collected in 1996 and 1997, respectively. The exceedances calculated using these data are considered applicable through 1999, because the evidence for temporal trends in these species is ambiguous, all of the segment- and year-specific average tDDT concentrations measured after 1991 in Dover sole and in white croaker in deeper waters are greater than 1.0 ppm (ten times higher than the California trigger level), and 100% of the samples measured after 1991 exceed 0.1 ppm.

For white croakers in shallow water, only data collected in 1999 in segments 6 and 7 are available. These values were considered applicable from 1992 to 1999 in these segments only.

The years of data availability and the periods of applicability for each species and critical concentration are listed in Table 2.

Table 2. Periods of Applicability and Years of Data Availability for Each Critical Concentration and Species

Species	Critical Value	Period of Applicability	Years of data availability (all segments)
Kelp bass	5.0	1981-1986	1981-1985
	5.0	1987-1991	1988-1996
	0.1	1992-1996	1992-1996
Dover sole	5.0	1981-1986	1983-1986
	5.0	1987-1991	1987-1996
	0.1	1992-1999	1993-1996
White croaker, deeper waters	5.0	1981-1986	1985
	5.0	1987-1991	1988-1997
	0.1	1992-1999	1992-1997
White croaker, shallower waters	5.0	1981-1986	1999
	5.0	1987-1991	1999
	0.1	1992-1999	1999
Black surfperch	5.0	1981-1986	1981-1985
	5.0	1987-1991	1990 – 1996
	0.1	1992-1996	1992-1996

3.3 Method of Calculation

Exceedances were determined for each species/time period/segment/depth combination by counting the number of data values with concentrations greater than the specific critical value, and then dividing by the total number of data values. Data values represent DDE measurements in individual fish or in composites of tissue from several fish. Exceedances were not calculated for species/time period/segment/depth combinations with less than five data values. For segments with less than five 5 data values, an exceedance value was chosen from another segment, if that represented a lower bound estimate for the segment with insufficient data. The following rules were developed on the basis that exceedances in all species are likely to show either no spatial gradient along the Palos Verdes Shelf or to increase monotonically towards the outfall, and that exceedances in any one segment are likely to have either not changed or declined since the early 1980s:

- If calculated values were available for two bounding segments, that is, for two segments, one on either side of the segment with insufficient data, then the minimum of the exceedance values calculated for the two bounding segments was chosen. Note that the bounding segments did not need to be adjacent to the segment with insufficient data.
- If a calculated value was available for only one bounding segment, then the exceedance value for that bounding segment was used if and only if it could reasonably be considered to be a lower bound estimate of the exceedance in the segment with insufficient data. This was considered true if the segment with insufficient data lay between the bounding segment and the White's Point outfall, that is:

If the bounding segment was:	Then the exceedance value for that segment could be used to estimate exceedances in segments:
2	3,4,5,6,7
3	4,5,6,7
4	5,6,7
5	6,7
6	7

- If calculated values were available for the same segment in a later time period, then the exceedance value for the later time period was used to estimate the exceedance in the earlier time period.

- If lower-bound exceedance values could be calculated in two ways, using a subsequent time period and using bounding segments, then the maximum of the values calculated by these two methods was chosen.

4. RESULTS AND DISCUSSION

The proportions of fish exceeding 5 ppm and 0.1 ppm are given in Table 3. Values presented in bold were calculated from data, and the number of data points is indicated. Values presented in italics were estimated following the rules presented in Section 3 above.

Sample sizes in segments for which exceedances were calculated range from 5 to 70. In some cases, exceedances are uniformly 100% or 0% throughout the Palos Verdes Shelf. In other cases, calculated exceedances tend to rise from the northwest portion of Palos Verdes Shelf (segment 3) towards the outfall. One exception to this pattern is for white croaker in deeper waters, for 5.0 ppm, for the period 1981-1986. Data are available for this period only for segments 6 and 9, while the exceedances for the other segments are set equal to measured and interpolated exceedances from 1987-1991. The measured exceedances in segments 6 and 9 for 1981-1986 are lower than the exceedances measured in segments 4A, 5, 7 and 9 for 1987-1996, which is inconsistent with general observation in fish, sediments and mussels, that exposure levels either remained the same or declined since the early 1980s (Figures 2 through 7, HydroQual 1997). Similarly, the average concentration measured in segment 9 in 1985 was lower than the average measured in 1990 in the same segment (Figure 2). This suggests that the exceedances estimated for segments 6 and 9 for 1981-1986 may underestimate the true exceedances in these segments during this period.

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